Inter-organisational Relationship and Conflict Resolution

Liuying Zhu and Sai On Cheung

Introduction

Interorganizational relationships describe the pattern of bonding among organizations. When independent and autonomous organisations have to work together like construction projects, effective bonding among them is essential [12]. Most of the theories on motivation are about individual behaviours. Moreover, in construction contracting, individual team members are agents of their respective organizations and do not participate merely as individuals [6]. Thus these motivation theories may not be directly applicable. In this regard, Guitot [24] clarified that organizations involve role relationships rather than interpersonal relationship. It has been argued that the ways in which individuals make sense of others' intentions and behaviours are subject to what role they are playing. This suggests that behaviour may change when individuals are performing in a role context. An individual may be willing to work with his counterpart in his "qua persona" relationships, and he may not be able to do the same in the capacity of a member of his organization. Studies of motivation in construction contracting should thus be carried out at organization level. In construction project, managing inter-organizational relationships (IOR hereafter) is a delicate but critical management function [37]. It is challenging to coordinate mega project team for involvement of large number of member intercommoned with a my mind of contractual network [57]. It has been commented that construction project team members work together in a temporary that has certain objectives. Moreover members also have their own interests too [6]. It is not uncommon to find these members are acting for the interest of their own organisation. Disputes and

L. Zhu (✉) · S. O. Cheung
Construction Dispute Resolution Research Unit, City University of Hong Kong, Hong Kong, China
e-mail: liuyinzhu3-c@my.cityu.edu.hk

S. O. Cheung
e-mail: Saion.cheung@cityu.edu.hk

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conflicts would surface when team members seek to maximize their own benefits at the expense of others [42]. Typically, their attitude would be defensive if not opportunistic. Major change in this type of working style is rigidly needed. Based on the analysis of four construction projects in Australia, Rose and Manley [52] found that seamless relationships underpin efficient project management. The linkage between IOR maintenance and project performance improvement is the focus of this study [39]. Four working objectives are listed:

(1) To conceptualize inter-organizational relationships in construction contracting;
(2) To examine the relationship between IORs and conflict resolution;
(3) To empirically test the relationship developed in (2); and
(4) To suggest ways to improve IORs.

Conceptualizing IOR in Construction

Oliver [49] developed six elements of IOR, which include (i) necessity (relationships are formulated because of legal requirements); (ii) stability (an adaptive response to environmental uncertainty); and (iii) legitimacy (organizations are motivated to interconnect for social reputation because of environmental pressure [49]. The other three IOR elements are efficiency, asymmetry and reciprocity. These elements are organization specific and may be established through contracts. In these regards, these three elements are used to identify IOR in this study. The following subsections articulate these elements in a construction context.

Efficiency

Transaction cost economics theory [58] illustrates that the formation of IORs can be invaluable to assist organisations to minimise costs of the transaction [49]. Cooperation among different organizations has been proved to be instrumental to raise efficiency. Organizations seeking to enhance inter-organizational cooperation are taking proactive steps to preserve valuable resources [2]. In fact, project monitoring systems are quite commonly used to control the use of resources. Attainment of specification is the minimum. Raising efficiency means achieving standard higher than the baseline requirements.

Asymmetry

Asymmetry between organizations can be expressed by the power or control one organization has over the other [49]. Whilst enhancing efficiency drives organizations to

cooperate, asymmetry may result in organizations attempting to exert power, influence, or control over other units, especially those having scarce resources. Contract governance is therefore used to shape, influence or control others' behaviour in a contractual relationship. Information differential may well be the most crucial form of asymmetry away contracting parties [26]. Principal-agent theory suggests that if a principal (developer) cannot observe the agent's (contractor's) behaviour properly, moral hazard will arise. In these circumstances, the agent will only maximize his own benefit even at the expense of the interest of the principal [53]. In response, the principal may seek to exercise greater control through the use of contractual power. Eisenhardt [17] proposed that observability through incentives or disincentives is a useful way to balance the information differential [17]. For construction projects, self-reporting and right to inspect are typically installed as part of the project management system to make the performance of contractors more observable [1, 11].

Reciprocity

The human instinct of altruism can be a powerful force to bring self-interested individuals to cooperate [19]. Effective multiparty coordination and equitable exchange characterise admirable IOR [49]. Exchange theory projected that cooperation can be reciprocal to the level of interdependency [18, 49]. Cheung et al. [10] did find that interdependency underpins IOR building. It is further advocated that by aligning parties' objectives, a more proactive, cooperative relationship among organizations can be resulted. Nonetheless, major cultural shifts from the self-interest focused mindset is needed [5]. Project members are then more likely to cooperate to achieve common goals when reciprocity can be expected. When this cycle becomes initialised, cooperative working will be more enduring.

The Relationship Between IOR and Conflict Resolution

Simon [55] pointed out that individuals are "passionate economists" when making decisions because their rationality is somewhat bounded. They may settle with "satisfying" instead of "optimal" outcomes. People are sensitive to the identified patterns of the relation exchange. For example, an individual with low status is more dependent on an individual with high status and is therefore more sensitive to relationship issues [20]. Similar sentiment is also featured in inter-organizational relationships. For example, people may feel angry about unfair transactions [22]. Without the possibility of restoring equity, distress may inhibit the development of IOR. Moreover, in the case of a lacking of mutual trust, cooperation is less likely. The natural consequence is ineffective communication between them.

Their business relationship will be worsen. They will become more non-cooperative with the state of distrust aggregates, When this happens, instead of

working together to face crisis or problems, opportunistic exploitation is the more likely scenario [41].

Effective contractual governance is therefore needed to manage IOR. Cheung et al. [10] illustrated that establishing interdependency can improve IOR. Sophisticated project management strategies can be devised to promote the smooth running of mega projects. Some classical examples includes the contractual use of joint risk management [47], partnerships [3], or information sharing platforms [54].

IOR is one of the primary contextual factors for effective project monitoring. Through analysing 113 capital projects, Suprapto et al. [57] suggested that a partnering/alliance contract with a positive relational attitude and good team working quality is likely to perform better than conventional contractual arrangements. It is further found that cooperative construction organizations help minimize transaction costs for projects of high uncertainty and complexity [39]. Relational contracting has been advocated as an effective means to improve performance and profit margins in construction projects [36]. Summarizing the abovementioned IOR elements, an IOR-project performance relationship framework is proposed and presented in Fig. 1.

Case Study: The PRES in the HZMB Project

To examine the proactively of the framework in practice, the Hong Kong-Zhuhai-Macao Bridge (HZMB) project is studied.

Project Particulars

The HZMB project is located at the Pearl River Estuary adjacent to the Hong Kong International Airport. This project was jointly initiated by the Guangdong Government, the Hong Kong Government and the Macao Government (the three governments hereafter). The HZMB has been planned to be one of the landmark infrastructures in China. The Hong Kong portion of the HZMB is also one of 10 major infrastructure projects initiated by the HKSAR Government [27, 29]. The HZMB used over 400,000 tons of steel that is enough to build 60 Eiffel Towers. It is recognized as the world's longest across channel bridge and the steel structure with the highest tonnage.

At the initial stage of the HZMB project, some basic principles in terms of finance, construction and operation were agreed upon by the three governments. In 2010, the Hong Kong Zhuhai Macao Bridge Authority (HZMBA hereafter) was established. The HZMBA is responsible to manage the construction, operation and maintenance of the HZMB project. The HZMBA has the following pledges [30]: (1) build a world-class channel; (2) provide high-quality service to users and (3) deliver a landmark bridge in China. In addition to these pledges, four major challenges were identified [30]: coordination, construction, technical difficulties and environmental protection.

(1) Coordination: The project was under the management of the three governments with different regulations, management systems and communication styles [61]. Complicated power relations and multilevel governance preserved extra challenges in a tripartite project [60].
(2) Construction: The three places had different construction standards and there had been no previous reference project to follow. The sophisticated construction tasks also require innovations. Many new techniques were needed. The collective effort of all parties involved was the only way possible to deal with the challenges.
(3) Technical difficulties: The project faced many unprecedented technical challenges. The changing state of the ocean current affected the formation of the artificial islands. There were also difficulties regarding sedimentation prevention in the immersed tunnel. Moreover, according to the construction specifications, advanced undersea waterproof materials needed to achieve a 120-year design life span.
(4) Environmental protection: The bridge is located across the Chinese White Dolphin National Nature Reserve District, comprehensive environmental measures were required to protect the marine ecology.

The case study for this study was based on the most critical and challenging portion of the HZMB and involves two artificial islands connected by a 6.7 km immersed tunnel (ATA hereafter) [30]. ATA is a new type of construction. First, the two artificial islands are surrounded by 120 steel drums as island walls. The eastern island contains 61 drums, and the western island contains 59 drums. Second, the immersed tunnel is the longest (5.7 km) and deepest (48 m) immersed tube tunnel in the world. The immersed tube tunnel is connected by 33 pipe joints, of which 29 are 180 m long. Four other immersed tubes connecting two artificial islands, which are 112.5 m long, consist of 5 segments [32]. Third, each standard immersed tube weighs 74 thousand tons, making these tubes the heaviest that have ever been fabricated. The technical challenges made the project exceptionally risky. The uncertainties were enormous. To capitalise on the expertise of the contractor, design-and-build procurement was used. The ATA project is therefore a super mega project characterized by features identified by Flyvbjerg [21]: (1) large-scale, (2) complex, (3) high value, (4) long period, and (5) having significant social impacts. Table 1 summarizes the particulars of the ATA project.

Flyvbjerg [21] found that most mega projects ended with cost overruns, delays and disputes. Nonetheless, the ATA project appears to be an exception. After eight years of exceptional efforts, the HZMB project was opened on time for use in October 2018. This was facilitated by many engineering and management innovations that include 450 patents that made the project completion meeting the planned schedule [30]. As an example, the new technology used for rapid island formation shortened the construction period by more than two years. All of the technical accomplishments together with the management experience will benefit similar cross-channel bridges and immersed tunnel mega projects in the future.

Table 1 Particulars of the ATA project

Project particulars		Description
1	Scope of work	1. Permanent works a. Overall design of the artificial islands, tunnel b. Construction work of artificial islands, tunnel, etc. 2. Temporary works a. All temporary work for the required permanent project, such as planning, dismantling and restoring the original form b. Construction and dismantling of relevant camps
2	Procurement method	Design and build
3	Contracting arrangement	Joint venture
4	Project contract value	The estimated cost of the whole project is about 13.1 billion RMB
5	Form of contract	FIDIC (with modifications)
6	Payment period	Quarterly
7	Contract duration	Maximum 75 months
8	Commencement date	January 2011
9	Time for completion	83 months
10	Date of completion	December 2017
11	Defect liability period	5 years

In view of the expectations of the governments and people of the three places, embracing the concerted efforts of the project team members was top priority for the project management team. A project reputation evaluation system (PRES) was devised. PRES serves as a project management tool. In addition, the disincentivisation arrangements heled in creating state of interdependency between developer and contractor. Given the success of the ATA project, insightful lessons can be learned from understanding the operation and value of the PRES. The analysis of PRES was carried out from two perspectives:

(1) The use of the PRES as a project control tool in the ATA project and
(2) Anecdotal evidence of the PRES in promoting IORs and reducing construction conflicts.

The Use of the PRES as a Project Control Tool in the ATA Project

PRES was designed to assist the HZMBA to manage this challenging project. Given the enormous difficulties and expectations, the HZMBA realized that working closely with the contractors was necessary [62] so that problems can be tacked on the spot.

At the same time, the effort of the contributors cannot be ignored. On these bases, the HZMBA decided to include these anticipations in the contract governance through a project reputation evaluation system (PRES) [8]. To start the case study, a pilot study was first conducted with 10 senior project team members to have an overview of the project management strategies. The findings from the pilot study are summarized as follows:

(1) The PRES was a primally a useful **project control tool**. As the initiator of the PRES, the HZMBA confirmed that the design of the PRES aimed to cover all key targets of the project. Therefore, the PRES scores thus can indicate the overall performance of the contractor. The PRES seeks to detail all forms of non-compliance behaviours so that compliance or otherwise can be assessed on a quarterly basis. The scores were used to pinpoint existing or upcoming problems.
(2) The PRES was also instrumental in building **IORs**. All the interviewees agreed that the detailed reporting required by the PRES had indirectly forced the stakeholders to communicate openly because they were all inter-connected. opined that the PRES improved interorganizational communication, which was vital in speeding up decision making. At the beginning of the project, the project team members were not familiar with each other's management styles. Moreover, the PRES systemised somewhat what and when responses were needed. Thus following a system avoided surprises. In fact, the PRES facilitated communication and exchange of observations. When the parties became more familiar with each other, the number of non-compliance behaviours dropped notably. Communication and the sense of involvement were further enhanced through the opportunity of discussing the quarterly scores by the contractor with the evaluation offline.

The PRES therefore worked like a special project management tool for the ATA project. The PRES has 148 clauses. To motivate the contractors' performance, disincentivisation arrangements were also installed to work with the PRES.

The PRES had four principle functions:

1. **Goal commitment**

All the project pledges and key milestones were operationalised in the PRES as 6 project goals:

(1) Quality management: Ensure that the project had a 120-year life span and met all the required standards with a 100% acceptance rate.
(2) Health, safety and environment (HSE) management: Pursue zero injury, zero pollution and zero accidents in this project. Reach the advanced level of construction project requirements in health, safety and environmental management. Protection of white dolphins was specifically stated.
(3) Procedure management: (1) Completion on time. (2) Maximum utilisation of resources. (3) Total management plan to cover works, quality and budget control.

(4) Cost Control: (1) Cost efficiency is considered from a life-cycle perspective. The cost management of the project referred to the life cycle cost efficiency and value management. All life cycle cost measures (such as agency costs (ACs), user costs (UCs), and environmental costs [51]) were developed based on the "Measures for the Preparation of Investment Estimation for Highway Engineering Capital Construction Projects" [46]. (2) The preliminary design estimate should be maintained with a tolerance of ±10%. (3) The total cost move over should be the estimate for approved preliminary design.
(5) Information management: Establish an information sharing system to support the holistic management of the project due regard to regulations of the these governments.
(6) Innovation: Cultivate scientific innovations in technology and management to promote project efficiency.

2. **Reward/Responsibility reallocation**

Two percent of the total contract value was set aside to support the operation of the PRES. Performance thresholds were set based on previous project performance records collected from the evaluation committee (EC) of the HZMBA. The thresholds were used as reward attainment targets.

3. **Monitoring method**

Comprehensive evaluation was carried out quarterly by the EC, whose members were the heads of different departments of the HZMBA. The responsibilities of the EC include:

(1) Setting detailed standards according to the contents of each assessment;
(2) Organizing quarterly meetings to report and discuss performance evaluations;
(3) Examining the final assessment scores; and
(4) Evaluating the creditability of the contractors.

4. **Performance Assessment**

The EC conducted independent performance evaluation on contractors according to the grading guidelines. The maximum score was 100, and the score distribution according to different project goals is shown in Table 2.

The evaluation was carried out by way of mark deduction according to a predetermined scale included in the tender document. When project inspectors from the EC observed non-compliance behaviours, the points would be deducted accordingly. If a contractor made major errors or deviated from the provisions stipulated in the

Table 2 Percentage weightings of different targets

Item	Quality	HSE	Procedure	Cost	Information	Innovation
Ratio of score (%)	35	35	15	5	5	5

Table 3 The performance level and respective payment ratio of the PRES

Comprehensive evaluation score: L	Performance assessment grade	Payment adjustment ratio
$L \geq 90$	AA	100%
$85 \leq L < 90$	A	90%
$80 \leq L < 85$	B	70%
$75 \leq L < 80$	C	50%
$L < 75$ or the qualification is cancelled	D	0

contract, the assessment would be 0 points. Cost penalties would be enforced. In addition, other penalisations like down quality of credentials was also possible. The calculation of the project performance score in each quarter is shown in Eqs. (1) and (2):

$$Deduction_i = \sum (D_1 + D_2 + \ldots + D_n) \tag{1}$$

$$PERSC_i = SC - Deduction_i \tag{2}$$

where $Deduction_i$ = The overall deductions for non-compliance behaviours in quarter i. According to the project duration, there were 28 quarters in this project.

$D_1 \ldots D_n$ = The recorded deduction for the specific n non-compliance behaviours in quarter i.

$PERSC_i$ = The performance score in quarter i.

SC = The total performance score (typical value = 100).

Performance was directly linked to the payment adjustment system in the PRES [50, 33]. Table 3 summarises the payment ratios according to the performance assessment results.

A contractor that received two consecutive "D" grade was considered to have breached the contract, and the HZMBA could terminate the contract. Deductions were implemented according to the performance score of each quarter if the EC observed any non-compliance behaviours according to the PRES requirements. All the scores, together with the rankings of all the contractors, were announced each quarter. The specifications of the PRES are given in Table 4.

The Incentivizing Functions of the PRES

For project performance, the PRES functioned as a contractual project control tool. The primary design of the PRES was to formalise working targets and rewards. The clear requirements were established through consultation and served as the catalyst in

Table 4 The Specification of the PRES

Item	Project reputation evaluation system
Main objective	Improve this project's performance based on different goals
Goals and distribution of scores	Quality (35%); HSE (35%); Procedure (15%); Cost (5%); Information management (5%); Innovation (5%)
Bonus/penalty ratio	2% of contract value
Nature of Incentivisation	Disincentivisation
Payment method	The payment of the bonus was integrated into every interim payment
Evaluation method	Quarterly
Assessment method	The calculation was mainly by deductions. A form of classified payment was set. (Scores over 90 -100%, descending in turn)
Future chance for bidding	The performance was noted as a reference for future tendering. Contractors with high scores would be given priority
Feedback from the contractors	The deduction was too harsh in the first quarter. Negotiations were conducted to enhance flexibility after the first quarter

bring about the utmost efforts of both the developer and the contractor [7]. Eisenhardt [16] and Hosseinian [31] suggested that for monitoring highly programmable tasks, setting clear rewards/punishments is the prerequisite. Clear targets minimize the chance of misunderstanding the expectations. Furthermore, breaking down tasks into more discrete packages can make the targets more manageable [31, 58]. For construction projects, clear targets capitalise expectations [31]. Agency theory also postulates that the criteria and measurability of performance should be prepared by the principal [16, 17]. Outcome-based behaviours have only a partial control effect, while behaviour monitoring helps synchronize multiple goals [13, 15]. In the ATA project, the PRES offered both project monitoring and performance incentivising function [35].

The review of the PRES also pinpointed the importance of promoting IOR and enhancing project performance [31, 45]. In the ATA project, this was mainly reflected as the incentivising effect. Two percent of the total contract value was designated as the 'reward' of the PRES. Incentivisation and disincentivisation are regularly used as project control measures to alleviate opportunism in construction projects [7]. Reward will be given when performance exceeds agreed targets while underperformance will be penalised [9, 44]. Many studies have analysed the use of incentive schemes in reducing disputes and nurturing innovation [33]. Oliver [48] found that disincentives can raise unanimous cooperation. Disincentives are costless when compared with a positive financial bonus. In an ideal situation, if everyone cooperates, the cost of disincentives is only the design and implementation efforts [48].

The pilot interviews provide guidance for understanding the effect of the PRES. Many interviewees considered that the PRES was valuable system to manage IOR. As a result, they were willing to cooperate [31, 45]. Table 5 shows the IOR elements and the devices under the PRES.

Table 5 The IOR elements as vehicles under the PRES

No.	IOR element	Intention	Devices through project monitoring:	Manifestations in the PRES	Key references
1	Efficiency	An organization's attempt to improve its input/output ratio	Setting tasks as highly detailed contractual specifications to achieve specific project objectives	"The Authority set six major project targets with plans to monitor and assess the project performance" "Project team members with better assessment results should be given full-line notification and praises, while those with worse assessment results should be reported and criticized. Rewards or penalties should be released based on the assessment of the performance"	[23, 58]
2	Asymmetry	The potential to exercise additional power or control over another organization and/or its resources	Improving observability through setting programmable tasks	"In the process of project construction, the participating units strictly comply with the requirements of objectives, norms, contracts and documents. The Authority should supervise and inspect the implementation of relevant requirements. Assessment should be conducted in each quarter to ensure that the quality of project construction is always under control"	[4, 15]

(continued)

Table 5 (continued)

No.	IOR element	Intention	Devices through project monitoring:	Manifestations in the PRES	Key references
3	Reciprocity	Emphasizes cooperation, collaboration, and coordination among organizations, rather than domination, power, and control	Aligning the objectives of all project members and promoting cooperation	"All the project team members shall follow the outline for the HZMB project, with the aims to (1) build a world-class oversea channel, (2) provide high-quality services for users, and (3) become a landmark bridge in China" "On the basis of the strict implementation of contracts, this project promotes the concept of a win–win partnership and integrated management for all project team members"	[18, 49]

Adopting the abovementioned IOR framework (Fig. 1), the framework for the ATA project is presented in Fig. 2.

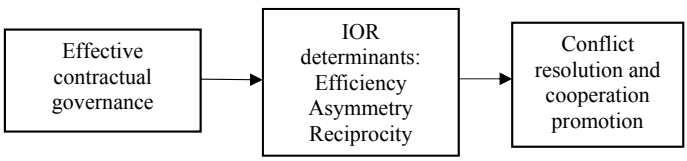

Fig. 1 An IOR project performance relationship framework

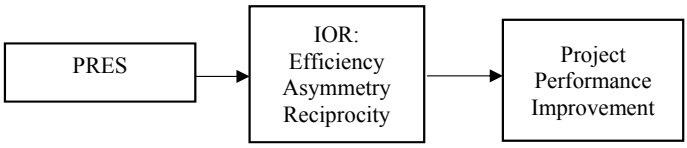

Fig. 2 An IOR-project performance relationship framework

Anecdotal Evidence of the PRES in Promoting IOR

Figure 2 hypothesized the potential linkages between the PRES, IOR and project performance improvement. Further evidence was sought through the following:

(1) Trend Analysis

Trend line analysis was performed in order to obtain the pattern of change overtime [25]. Such analysis can track the changes in project performance as well as the IOR elements during the project duration. There are two parts of data analysis:

(i) Part A: Investigate the evidence of IOR improvement respective to project goals.

To accomplish this objective, 28 sets of quarterly PRES evaluation scores covering the overall 8-year construction period were examined. The data include all the non-compliance behaviours of the main contractor. 197 non-compliance behaviours were recorded with deductions of performance scores. These non-compliance behaviours are first classified with reference to the six goals (Quality, HSE, Schedule, Cost, Innovation, Information management). To further investigate the intention of making all these deductions, the non-compliance behaviours were further grouped with reference to the IOR elements. Trend line were plotted by the log value of the scores. Trend line analysis was considered the best fit when the rate of change in the data increased or decreased quickly and then levelled out [14]. As hypothesized, the deductions related to the three IOR elements showed a gradual drop.

(ii) Part B: Investigate the influence of different IOR elements on general project performance improvement.

The second part of data concerned the analysis examines the relationship between the three IOR elements and the overall project performance. The trend of the scores may show if the PRES had helped achieving the project outcomes. Thus, this part of data analysis aim to examine (a) whether the contractor had achieved the specific performance level as expected; and (b) in what ways the IOR elements contributed to the achievement of the project objectives.

A second round of discussion was then conducted with key project team members to comment on the observations of the trend analysis. Figure 3 summarises the flow of the data analysis.

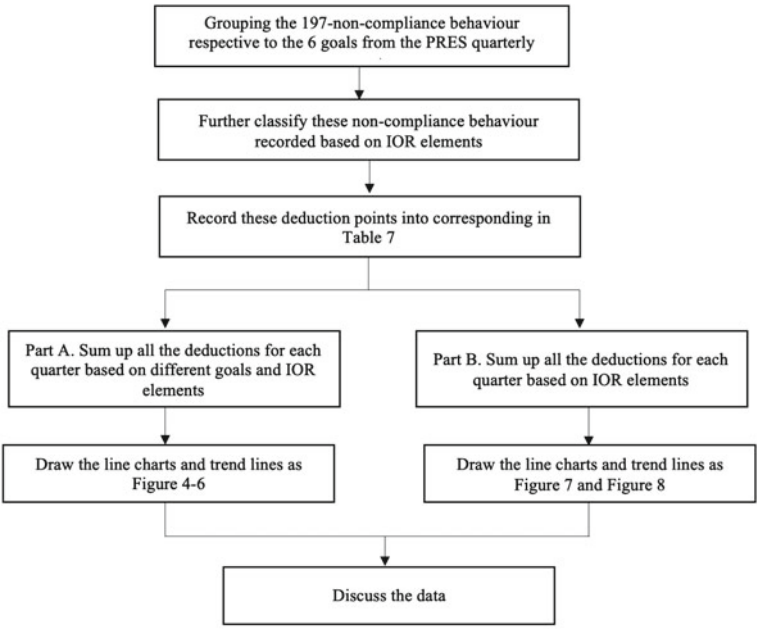

Fig. 3 Flowchart of the empirical study

Part A. The evidence of IOR enhancement

As mentioned in the previous section, to evaluate how the IOR concept was developed in this project, all non-compliance behaviours were grouped respective to the six project targets. To further evaluate the development of IOR in the ATA, all these non-compliance behaviours were then grouped respective to the three IOR elements. Table 6 shows how the data were grouped.

Table 7 shows the distribution of the deductions based on different project objectives and IOR elements.

With reference to Table 7, there had been major deductions for non-compliance of quality and HSE targets. However, no deductions were found for the cost target and only a few for procedure, information and innovation. Ever with deductions, the deduction ratio was relatively small and did not have significant effects on payment. Thus, quality and HSE were having the most influence on the overall score. For the IOR elements, the differential was also seen in different project targets. Asymmetry and efficiency represented similar portions of deductions on quality. However, for HSE, most of the deductions were related to efficiency. The general decreasing trend of deductions for quality and HSE are noted in Fig. 4.

The deductions on quality gradually reduced. The deduction dropped from 8 to 4 for the quality scores. However, the performance score for HSE fluctuated. Comparatively, from Q1 to Q28, the deductions of HSE fluctuated around 2. The relatively larger drop in quality non-compliance behaviour suggests that the PRES

Table 6 Sample for the data analysis

No.	Assessment period	Non-compliance behaviours	Quarterly deduction	Category	
				Goal	IOR elements
1	Q1	Overall quality plan not submitted in time	1.0	Quality	Asymmetry
2	Q1	Poor quality plastic drainage board for soft foundation treatment found in construction camp	2.0	Quality	Efficiency
3	Q2	Poor coordination between the constructor and the designer	1.0	Quality	Reciprocity

were having effect. The trend analyses for the other IOR elements are shown in Figs. 5 and 6.

These two figures present the changes in the three IOR elements. A clear decreasing trend is shown for asymmetry in both quality and HSE. However, for efficiency, there is an opposite trend for these two targets. A decreasing trend of efficiency was detected in Fig. 5, while a slight increasing trend was noted for HSE (Fig. 6). There was basically no change for reciprocity in either quality or HSE.

Part B. The roles of IOR in project performance improvement

To obtain an overall view of how these three factors influenced project performance, a trend analysis of the project performance scores achieved by the design and build contractor was prepared (Fig. 7).

Figure 7 shows that except for the first quarter, the performance scores were consistently above 90 points. This means that the contractor obtained 100% of the expected payment except in the first quarter (90% for that quarter). For the general trend, there was a slight increase at the beginning, after which very slight increase was noted. The average score fluctuated around 93 representing a 3% higher than the baseline of grade AA (Table 7). This result seems resonating the optimizing behaviour of contractor identified by Wong et al. [59] who found that most contractors were "optimizers" and adjusted their resources to sustain their performance at a level that would not jeopardise their future work opportunities. There were no serious attempt to maximise their performance.

To further investigate the contribution of IOR elements in this project, analysis of the total deductions was also conducted. Figures 8 shows the trend of the total points deducted the three IOR elements.

Figure 8 shows that there was basically no change in reciprocity related deductions. In contrast, the deductions regarding asymmetry and efficiency decreased after

Table 7 The distribution of the deductions based on different project objectives and IOR elements

Quarter (i)	Quality 35%			HSE 35%			Procedure 15%			Information 5%			Innovation 5%			Cost 5%	PERSC
	As	Re	Eff	As	Re	Eff	As	Re	Eff	As	Re	Eff	As	Re	Eff		
1	4.5	0	3.5	0	0	3	0.5	0	0	0	0	3	0	0	0	0	85.5
2	3.5	0	0	1	0	2	0	0	2	0	0	0.5	1	0	0	0	90
3	3.5	1	4	0	0	0	0	0	0.5	0	0	0	0	0	0	0	91
4	0	0	4	0	0	0	0.5	0	0	0	0	0	0	0	0	0	95.5
5	3	0	2	0	0	3.5	0	0	0	0	0	0	0	0	1	0	90.5
6	2.5	0	1	0	0	3	0	0	0	0	0	0	0	0	0.8	0	92.7
7	2.4	0.5	2	2	0	0.5	0	0	0	0	0	0	0	0	1	0	91.6
8	2	1.5	1.5	0	0	1.5	0	0	0	0	0	0	0	0	0	0	93.5
9	0	1	3.5	0	0	1	0	0	1	0	0	0	0	0	0	0	93.5
10	0.5	1.5	0	0	1.5	0.5	0	0	1	0	0	0	0	0	0	0	95
11	0.5	0	3.5	0	0	2.5	0	0	0	0	0	0	0	0	0	0	93.5
12	1	1	1	0	0	1.5	0	0	0	0	0	0	0	0	0	0	95.5
13	2.5	0	2	0.5	0	0	0	0	0	0	0	0	0	0	0	0	95
14	0	1	5	1	0	2	0	0	0	0	0	0	0	0	0	0	91
15	3	0	1	0	0	3	0	0	0	0	0	0	0	0	0	0	93
16	1.5	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	94.5
17	3	1	0	0	0	4	0	0	0	0	0	0	0	0	0	0	92
18	3	1	0	0	0	4	0	0	0	0	0	0	0	0	0	0	92
19	5	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	93
20	0.5	0	1.5	0	0	4	1	0	0	0	0	0	0	0	0	0	93

(continued)

Table 7 (continued)

Quarter (i)	Quality 35%			HSE 35%			Procedure 15%			Information 5%			Innovation 5%			Cost 5%	PERSC
	As	Re	Eff	As	Re	Eff	As	Re	Eff	As	Re	Eff	As	Re	Eff		
21	1	0	2.5	0.5	0	2.5	0	0	0	0	0	0	0	0	0	0	93.5
22	2.5	3	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	94
23	0	0	3	0	0	0.5	0	0	1	0	0	0	0	0	0	0	95.5
24	1	0	0	0	0	5	0	0	3.5	0	0	0	0	0	0	0	90.5
25	0	0	3	0	0	3	1	0	0	0	0	0	0	0	0	0	93
26	1	1	4.5	0	0	2	0	0	0	0	0	0	0	0	0	0	91.5
27	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	97
28	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	98
Sum	**47.4**	**15.5**	**52**	**5**	1.5	**55**	3	0	9	0	0	3.5	1	0	2.8	0	85.5
%	**41%**	**13%**	**45%**	**8%**	2%	**89%**	25%	0%	75%	0%	0%	100%	26%	0%	74%	–	

Note As = Asymmetry; Re = Reciprocity; Eff = Efficiency; PERSC = Performance score

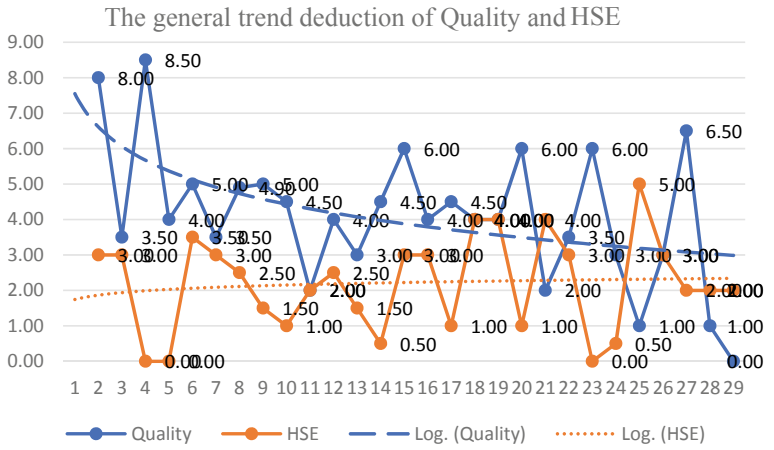

Fig. 4 The general trend of deduction of Quality and HSE

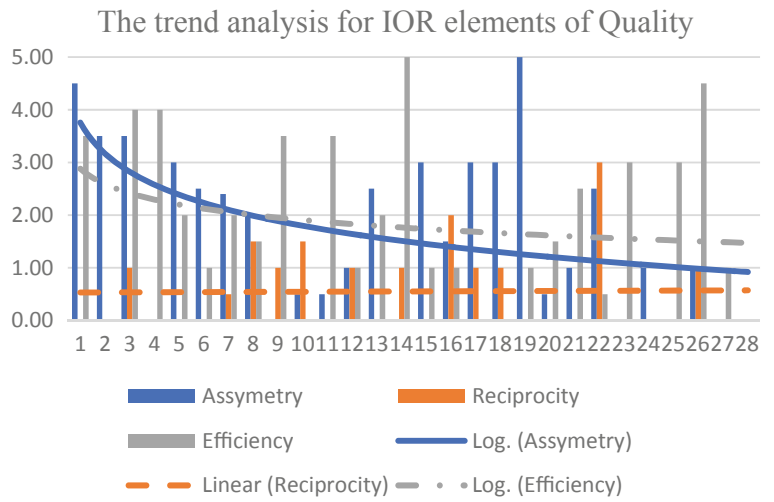

Fig. 5 The trend analysis for IOR elements of Quality

the first quarter. These echo the comments by the interviewees that a more understanding and reasonable approach to evaluate performance had been adopted after the learning from the first quarter. After the first few quarters, the decreasing trend of efficiency became very marginal. Conversely, there was a significant drop in asymmetry. At the final stages of the project, in Q24, Q26, Q27 and Q28, there were no deductions relating to asymmetry.

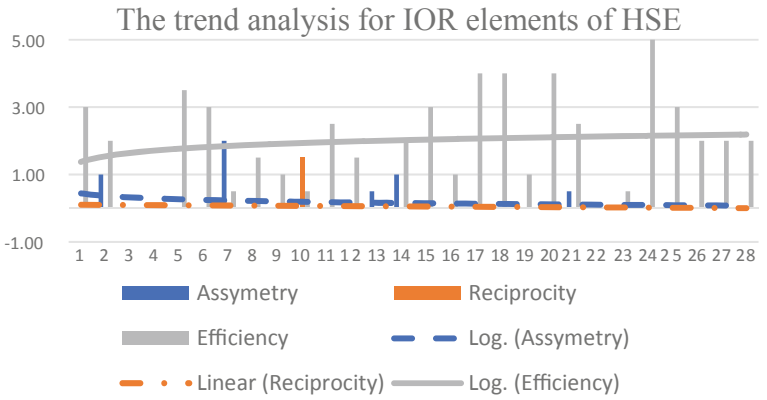

Fig. 6 The trend analysis for IOR elements of HSE

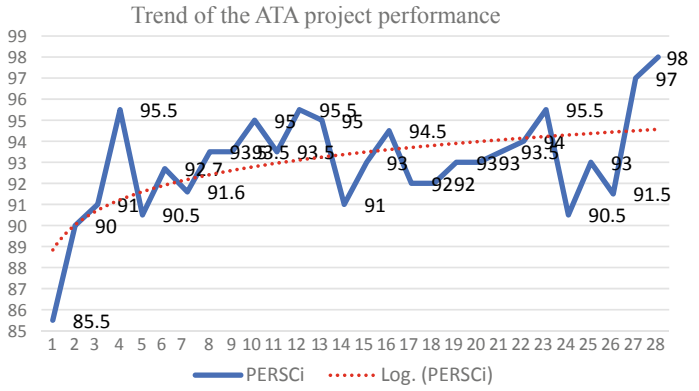

Fig. 7 Trend of the ATA project performance

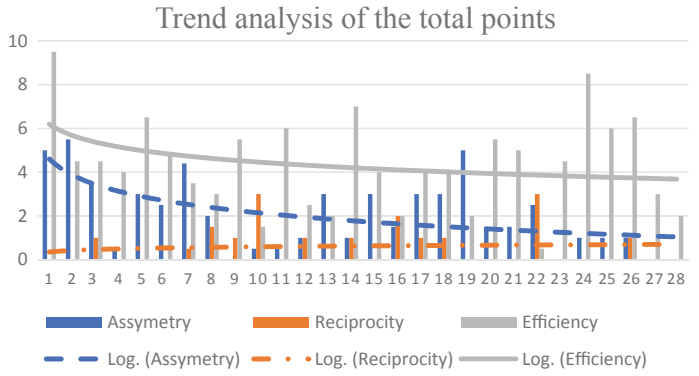

Fig. 8 Trend analysis of the total points

Discussion and Recommendations

Discussion of the Data Analysis Results

As part of the validation, the trend analyses and the interpretation were presented to the major ATA project team members. This part of the work is to validate the observations.

Four project team members joined the discussion session. Two represented the HZMBA and the other two were from the contractor. All of them had participated in the project throughout the whole construction period. Their opinions are summarized as follows:

(1) The PRES had been instrumental and most effective to manage quality target.

Both the contractor and the developer argued that the PRES was useful in monitoring the contracting behaviours of all parties under the evaluation by the PRES. In essence, non-compliance behaviours were recorded and discussed during the evaluation process. This had the benefit of retrospective review of ten the result was released. In this way less conflict was resulted. All the project targets were achieved at the end of the ATA project. The rise in project performance and the lowering of deductions were very pleasing for all stakeholders. Notably, upholding the quality targets was most challenging and indeed quality issues was more common in a mega project like ATA. The end result was very satisfying as quality was attained through many innovate efforts.

(2) The PRES was instrumental in building IOR.

In terms of IOR building, the PRES was also invaluable In enhancing the communication among the parties. At the beginning of the project, the organizations had yet known each other well enough. Deductions levied by the HZMBA had led to open communication between the HZMBA and the contractor. The discussion after the first quarter deduction served as alarm belt. The contractor had then adjusted her work force and raise her performance above the PRES targets. The parties since then had become much more engaged. The conflict between them was minimised.

The PRES was thus effective in managing IOR. The performance score was kept at a satisfying level. The different movement trends of the three IOR elements reflected the different degrees of the impact of the PRES on IOR. The major changes were effected on asymmetry. The sharp drop in deductions for asymmetry was likely due to enhanced information exchange between the HZMBA and the contractor. For each quarter, outstanding information and unsubmitted materials were raised and discussed as and when points were deducted from the scores. Accordingly, remedial or follow up actions will be installed for the next quarter. Both parties confirmed that exchanges of useful information were achieved during the whole project process.

The following summarizes the findings of the trend analyses and the views of the interviewees.

(i) The importance of setting performance targets

Among the six project goals, significant impacts on performance as primarily on quality and HSE. No deductions were recorded for cost. In fact, the contractor had very little relation with the project cost because the ATA project was a lump sum contract. In general, the HZMBA was less concerned about the cost than the contractor. For information and innovation, the contributing ratio are relatively small and in deed very few points were deducted. The low deductions support that showed the effective communication between the two parties was quite effective after then goals were aligned and crystalised through PRES.

(ii) Trend Analysis

- There was significant project performance improvement during the project. The improvement in quality was most notable.
- The improvement in asymmetry was more apparent than efficiency and reciprocity.

The PRES appeared to be able to balance information asymmetry and enhance inter-organizational communication during the project execution stage. A substantial drop in the project efficiency score was recorded for the first quarter. After Q23, the reduction in project efficiency presented basically no change. The trend of asymmetry deductions generally reached to zero. Suggesting that their communication had become seamless.

The deductions also show that imperfect information sharing existed at the beginning of the project. Although design and build procurement is considered a good way to integrate design and construction, research also shows that project delivery methods do not differ significantly in soliciting cooperation [38, 40, 54]. Some researchers have suggested that the source of motivation is not at the individual level but rather at the organizational level [6]. Effective contractual management and appropriate incentives can enhance communication and prevent opportunistic behaviours. The PRES helped improve project performance directly by enhancing interdependency and fostering cooperation [10]. The interviewees commented that despite the observation of no significant improvement in the three IOR elements, the PRES as a whole served as a means to bring the organizations together in terms of language, communication mode and performance goals.

Recommendations for Project Management

This study harvested valuable insight on construction project management:

(1) IOR enhancement as an integral part of contract planning and implementation

It has been well reported that amicable IOR could bring about conflict avoidance and performance improvement. Building IOR is therefore very well worthy. Relationship

investment should therefore be an integrate part of project management [6]. If people enter into arrangements with the belief that their counterparts will present self-serving behaviours, they will adopt a defensive attitude. To guard against this, relational contracting [56] and invest on relationship can be a good strategy to cultivate IOR, To this ends, establishing a spirit of mutual trust and cooperation was considered absolutely necessary at the beginning of the project. For the ATA project, fostering IORs was on the top of the agenda. IORs aligned the project objectives of all the project members and aimed to promote cooperation.

(2) The use of incentivisation to reduce opportunistic behaviours

Both financial and nonfinancial rewards have been regularly used in construction projects to engender extra efforts. Can this be extended to cultivate IOR? The empirical evidence provided by the HZMB ATA project provided an affirmative answer. When parties' interest are aligned by the common goals like the reward targets of an incentive scheme, their attention would be directed to cooperate for the reward instead of raising dispute. Incentive schemes also bridge the asymmetry between the parties. As a result their relationship would be improved. The PRES of the ATA project was an exemplar. Several features of the PRES are worthy to be mentioned have. The publication of evaluation scores offered unintended motivator on the participating contractors as none of them would like to be seen as the 'black sheep'. Nonetheless, the PRES also has its contributor as most participating units were satisfying rather than maximising. Nevertheless, the PRES created the platform whereby the parties could stay away from the conventional opportunistic game plan.

(3) Close project monitoring as an effective way to reduce project conflicts

Based on principle-agent theory [17], opportunistic behaviour may occur when the principal (developer) cannot properly monitor the behaviour of the agent (contractor). Extra-contractual tools to reduce information asymmetry would be useful from the perspective of the principal. In the ATA project, the PRES provided the deadly needed platform for open information exchanges. The PRES addressed all major project objectives and guided innovative quarterly performance reports. The developer took a proactive role in setting performance standards and was committed to implementing the disincentivisation arrangements. More importantly, when necessary and appropriate, the working targets were adjusted to reflect the practical situation [43]. Because of that, many problems faced during the projects were brought up in the quarterly meetings. The scores reflected indicators of the performance level with scores lower than the agreed target indicated underperformance. The open performance reporting system helped reduce the likelihood of disputes and opportunistic behaviours. For mega projects, therefore, there is no substitute for well-planned project targets and dedicated project monitoring and control. By addressing information asymmetry and raising efficiency, the chances of the principal and the agent working cooperatively is not an impossibility.

Summary

Inter-organizational relationships (IORs) in construction contracting provides the bonding construction project team members. It is widely accepted that engendering motivation should be pitched at organizational level for construction projects [6]. In fact, managing IORs among contracting parties in mega-construction projects is particularly challenging. Non-cooperative attitudes and opportunistic behaviours are quite common in these complex mega projects. Effective contract management is thus essential to regulate contracting behaviours and promote cooperative working. The relationship between IOR maintenance and conflict resolution was investigated in this study that has four objectives: (1) to identify IOR concepts in construction; (2) to discuss the relationship between IOR and conflict resolution; (3) to verify the relationship through empirical study; and (4) to suggest ways to improve IORs. Efficiency, asymmetry and reciprocity were identified as the key constructs to conceptualize IORs in construction contracting. An IOR-project performance relationship framework was proposed. The Hong Kong-Zhuhai-Macao Bridge (HZMB) project offered valuable empirical evidence to support the proposed relationship framework. The HZMB project demonstrated exemplary use of disincentivisation arrangements in the forms of a project reputation evaluation system (PRES). The PRES was found to act as both a project monitoring tool and an incentivising agent. To further investigate the effects of the PRES in building inter-organizational relationships, 28 quarterly evaluation scores under the PRES were analysed. Analysing from the results of the trend analyses and two rounds of focus group discussions with key team members of the project, it was found that (1) IOR enhancement should be an integral part of contract planning and implementation; (2) incentivisation should be used to reduce opportunistic behaviour; and (3) IOR enhancement is an effective way to reduce conflict and hence disputes.

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